Scale Matters

Friday, November 16, 2001

Preliminary Conference Abstracts

Defining Restored Chesapeake Bay Water Quality From the Fish, Crabs, Oysters and Grasses Perspective.

Rich Batiuk, EPA Chesapeake Bay Program.

9:45 - 10:15 a.m.

ABSTRACT: A centerpiece of the Chesapeake 2000 Agreement was the 2010 goal to restore Bay water quality to the point where the Chesapeake and its tidal rivers can be removed from the list of impaired waters. As a critical step towards that goal, the Bay watershed states have committed to developing and adopting a set of Chesapeake Bay specific criteria and designated uses as state water quality standards. Dissolved oxygen, water clarity and chlorophyll criteria along with a set of habitat-based designated uses are being developed to define restored Bay water quality. How existing tidal water quality compares to these draft criteria and implications for implementation of an expanded tidal monitoring network for the Chesapeake Bay will be presented.

Sediment and Scale in the Chesapeake Bay.

Michael Langland, USGS/WRD, Lemoyne, PA.

10:45 - 11:15 a.m.

ABSTRACT: Basin size (scale) is a critical consideration when describing sediment processes. The integral process of sediment source, transport, storage, and delivery will vary considerably upon spatial scale and location. This presentation will examine examples of selected sediment processes at scales ranging from the Chesapeake Bay Basin to small farm fields.

Implications of Scale and Watershed Size for Management Approaches: An example Relating to Biocriteria.

Rich Eskin, Maryland Department of the Environment.

11:15 - 11:45 a.m.

ABSTRACT: As Maryland transitioned biocriteria from a assessment tool for environmental management, to a tool for regulatory decision-making relating to designated use support and impairment, several issues of scale became apparent. Possible scales for decision-making ranged from the 75-m sampling segments, to river segments, to 12- or 8-digit watersheds. The implications of each of these scales to management decisions will be discussed.

Maryland Stream Waders - an Innovative Statewide Volunteer Stream Monitoring Program.

Dan Boward, Maryland DNR

Concurrent Session A, 1:00 - 2:30 p.m.

ABSTRACT: Maryland Stream Waders is a statewide volunteer stream sampling program managed by Maryland DNR. Volunteers are recruited and trained by DNR staff and samples of benthic macroinvertebrates are collected using to Maryland Biological Stream Survey (MBSS) protocols. One goal of the Program is to increase the sampling site density (over that of MBSS) by choosing sites at a smaller scale. An overview of the program and selected results will be presented, as well as some challenges and successes from the first two years of the program.

Integration of State and County Stream Monitoring Programs.

Nancy Roth, *Jon Vølstad*, *Ginny Mercurio*, and *Mark Southerland*, Versar, Inc.,
Ron Klauda and *Paul Kazyak*, Maryland Department of Natural Resources,
Keith Van Ness, Montgomery County Department of Environmental Protection,
Wayne Davis, U.S. Environmental Protection Agency

Concurrent Session A, 1:00 - 2:30 p.m.

ABSTRACT: While the Maryland Biological Stream Survey (MBSS) monitors streams statewide, a number of Maryland counties also assess their streams, usually at a finer level of resolution. Integration of state and local efforts can improve the accuracy of stream condition estimates in local areas, reduce duplication of effort, and help agencies provide consistent and reliable statements to the public. Using the MBSS and Montgomery County Department of Environmental Protection programs as a case study, we investigated several key issues that must be resolved for effective integration: (1) differences in survey designs, (2) comparability of field and laboratory sampling protocols, (3) different indicators for rating stream condition, and (4) complexity and costs of integrated data analysis. Individual program objectives have historically led to different approaches by different agencies, so integration requires extensive information beyond the basic monitoring data. Information that must be obtained from both programs includes GIS files of streams, watershed boundaries, and geographic strata (used in site selection and indicator development); training of field personnel; field sampling manuals and field data sheets; and procedures for calculating Indices of Biotic Integrity (IBIs). Within the Seneca Creek pilot watershed, GIS analyses of the 1:24,000-scale map used by Montgomery County and the 1:100,000-scale map used by the MBSS revealed a large overlap in streams (202 stream miles), although a substantial number of additional streams were only found on the 1:24,000-scale map (120 stream miles). Field sampling protocols of the two programs are similar for fish, and no significant differences were found between fish IBI scores based on two versus three electrofishing passes. Preliminary analysis suggested that differences in benthic sampling and laboratory protocols (use of D-net vs. kick net, 100- vs. 200-organism subsampling, genus vs. family identification of chironomids) may affect benthic Ibis and resultant stream ratings. A field comparison study was designed and is underway to further investigate these factors. Site selection procedures vary between the two programs, although both employ random sampling to support watershed estimates.

Accounting for these differences, an analytical approach for calculating integrated estimates of stream condition was developed. In the Seneca Creek example, the relative standard error (RSE) for the integrated mean fish IBI was 4.9%, as compared to RSEs of 8.1 % and 6.1% for the mean Ibis based on MBSS and Montgomery, respectively. With the support of US EPA, these results and future integration of stream data by MBSS and Montgomery County provide a model example for integrating other county, local, and volunteer monitoring efforts.

Method Performance Characteristics and the Merging of Biological Assessment Datasets.

James B. Stribling, Tetra Tech, Inc.

Concurrent Session A, 1:00 - 2:30 p.m.

ABSTRACT: "Standard" protocols for performing biological assessments are actually a series of methods that, when performed together, can provide high quality data and estimates of biological condition. For example, assessment activities that specify rapid bioassessment protocols (RBP) use various specific methods for selecting sampling locations, field sampling, sample sorting, taxonomic identifications, data entry and data management, data analysis, and interpretation of conditions. Different approaches for accomplishing any of these steps may render two datasets or programs incomparable. Even if different programs purportedly use the same methods, each program may be unable to document performance characteristics. This makes combining datasets problematic, since there may be no way to evaluate uncertainty. Performance characteristics include concepts and calculations such as, for example, precision, accuracy, bias, representativeness, and completeness. In this paper, I describe development of one performance characteristic, i. e., percent taxonomic disagreement (PTD), a quantification of the precision associated with taxonomic identifications. I also illustrate the potential use of PTD as a QA/QC "control limit" for determining the taxonomic quality of a dataset, and its acceptability for direct comparison.

Channel Protection

Ted Brown and *Deb Caraco*, P.E., Center for Watershed Protection, Ellicott City, MD.

Concurrent Session A, 1:00 - 2:30 p.m.

ABSTRACT: It is widely accepted that urbanization can alter the geometry and stability of stream channels. Both anecdotal evidence and field research support the notion that the larger and more frequent discharges that accompany watershed development cause downstream channels to enlarge, whether by widening, downcutting, or a combination of both. Channel enlargement severely degrades the quality of instream habitat structure and sharply increases the annual sediment yield from the watershed. These two factors, in turn, are often correlated with the sharp drop in aquatic diversity frequently observed in urban streams .

Despite the large body of research available, many questions about the channel enlargement process in urban and suburban streams remain to be answered. For example, how much development can occur before a stream response is observed? Exactly how much will a channel enlarge, and how many years will it take to do so? Finally, what stormwater management strategies can engineers use to mitigate the amount of future channel enlargement?

While it is not easy to predict the absolute degree of channel enlargement caused by watershed development, it is clear that enlargement will occur in the absence of stormwater controls. Therefore, the challenge facing the engineering community is to develop and adopt stormwater management criteria that will provide adequate channel protection to minimize the extent of future channel enlargement. This paper explores some of the past and current approaches to providing channel protection through stormwater management criteria. The relative effectiveness of the criteria are discussed along with the inherent limitations of the various management approaches.

Issues, Challenges and Prospects of Water Resources Infrastructure in Urban Ecosystems.

L. E. Band, Department of Geography, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, *Neely L. Law*, Department of Geography, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599

Concurrent Session B, 1:00 - 2:30p.m.

ABSTRACT: A workshop was organized by the Baltimore Ecosystem Study (BES) in June 1999 to explore the role of water resources infrastructure on rural-urban ecosystem function. Many of the critical interactions between human society and ecosystems are mediated by the form, extent and function of water related infrastructure that develops over decades to centuries as part of the evolution of urban space. The term 'infrastructure' was broadly defined to include more than structural interventions of the natural system and encompasses the physical, ecological and societal aspects of water resource management system. The development and functioning of urban water resources infrastructure includes feedback loops between watershed and ecosystem conditions, economic demand, human perception of the environment, and the regulatory and management response to individual, community and institutional needs. Workshop discussions highlighted the need for an integrated conceptual framework to address water resources infrastructure but acknowledged the challenges such a framework presents. Key recommendations addressed: identification, measurement and modeling of hydrologic connectivity, spatial and temporal scaling of processes, and definition of an interdisciplinary paradigm that reflects the multiple dimensions of water resources infrastructure in urban ecosystems.

Evaluation of Stream Impacts from Leaking Infrastructure in the Lower Gwynns Falls Watershed.

Gary T. Fisher, (USGS) and *William P. Stack*, (Baltimore City).

ABSTRACT: Gwynns Run and Maidens Choice Run have been identified by Baltimore City as being among its most degraded streams. Leaking water infrastructure in the watersheds is suspected to have significant impacts on water quality of the receiving streams. A study is ongoing to identify sources of contamination and evaluate methodologies for identifying contaminants and possible surrogates. Initial sampling indicates that selected organic compounds are useful as indicators of leaking sanitary sewers, including fecal constituents, human pharmaceuticals, fragrances, and insect repellent. Longitudinal variations of stream discharge and water temperature may also be useful in evaluating

impacts of leaking infrastructure. Additional synoptic sampling and continuous measurements of discharge and water temperature are planned through at least September 2002, and will focus on identifying interactions among streams, storm-sewer, drinking-water, and sanitary-sewer systems.

Relating Instream Biological Condition to BMP Activities in Streams and Watersheds.

James B. Stribling, *Erik W. Leppo*, Tetra Tech, Inc;
James D. Cummins, Interstate Commission on the Potomac River Basin;
John Galli, Metropolitan Washington Council of Governments;
Sharon Meigs, *Larry Coffman* and *Mow-Soung Cheng*, Department of Environmental Resources, Prince Georges County

Concurrent Session B, 1:00 - 2:30p.m.

ABSTRACT: Assessment of the effectiveness of any environmental management activity is dependent on stated (or implied) goals. Use of biological indicators to evaluate the success of stressor-control features in enhancing of protecting overall stream or watershed conditions requires that some numeric decision threshold be developed. The indicators are, thus interpreted with some understanding of their expected status in the absence of stressors. The stated goal(s) of stormwater (SW) management/best management practices (BMPs) such as detention/retention ponds, riparian revegetation, bank stabilization, grade control structures, of others, is the removal of buffering of stressors that cause receiving streams to be ecologically impaired. This paper presents findings from two case studies where a "BMP-assemblage" was evaluated without the benefit of calibrated biological reference conditions, and another where SW retention ponds, in isolation, were evaluated with calibrated reference conditions.

Nitrogen Fluxes in Urban Riparian Zones Institute of Ecosystem Studies.

Dr. Peter M. Groffman, Baltimore Ecosystem Study.

Concurrent Session C, 3:00 - 4:30 p.m.

ABSTRACT: [not currently available]

Nutrient Discharges from Watersheds Covering a Few Hectares to Hundreds of Square Kilometers.

T. E. Jordan, *D. E. Weller*, and *D. L. Correll*, Smithsonian Environmental Research Center

Concurrent Session C, 3:00 - 4:30 p.m.

ABSTRACT: By measuring discharges from small watersheds we can distinguish the effects of particular land uses, but can we extrapolate the results to larger watersheds? Using automated samplers, we have measured discharges of water, sediments, and nutrients from about 80 watersheds ranging in size from 0.06-900 km^2. For Coastal Plain watersheds less than 3 km^2, water discharge per km^2 often decreases with decreases in area. However, we can predict discharges of large watersheds by modeling the effects of land cover on material concentrations separately from the effects on water flow, basing flow models on measurements of watersheds >3 km^2. Our models successfully predict discharges of nutrients

from a 900-km^2 watershed, which includes reservoirs, point sources and land in the Coastal Plain and Piedmont. We are working toward scaling up to thousands of km^2. We have found that watersheds of a few km^2 or thousands of km^2 discharge similar proportions (20-30%) of their anthropogenic inputs of N.

Influence of Watershed Morphology and Sediment Biogeochemistry on Nitrate Fluxes to Streams.

Karen Prestegaard, University of MD, Department of Geology.

Concurrent Session C, 3:00 - 4:30 p.m.

ABSTRACT: [not currently available]

Application and Extension of TOPMODEL Concepts to Hydrochemical Processes in Small Watersheds.

Jeff P. Raffensperger, U.S. Geological Survey, Water Resources Division.

Concurrent Session C, 3:00 - 4:30 p.m.

ABSTRACT: TOPMODEL is a semi-distributed, physically based rainfall-runoff model that has been widely applied to examine processes that occur in small watersheds. Its advantages lie in its ability to simulate various contributions to the storm hydrograph (baseflow, saturation- and infiltration-excess overland flow) that match field observations, but with a parsimonious parameter set and relatively little calibration. The TOPMODEL concept(s) are easily programmed and have been programmed in a number of different computer languages and formats, and the procedural models that have resulted are typically not computationally intensive. As one example, Scanlon and others modified TOPMODEL to explicitly include subsurface stormflow (or interflow), in order to match observations of transient, perched water tables in the shallow subsurface at the South Fork Brokenback Run catchment in Shenandoah National Park, VA. The macroporous subsurface stormflow zone provides a hydrological pathway for rapid runoff generation apart from the underlying groundwater zone, a conceptualization supported by the two-storage system exhibited by hydrograph recession analysis. In this modification of TOPMODEL, generalized topographic index theory is applied to the subsurface stormflow zone to account for logarithmic stormflow recessions, indicative of linearly decreasing transmissivity with depth. Vertical drainage to the groundwater zone is required and both subsurface reservoirs are considered to contribute to surface saturation. In addition, simulated groundwater, subsurface stormflow, and overland flow components of discharge were used with measured stream water and lysimeter concentrations of dissolved silica to investigate the hydrochemical behavior of the catchment. Concentrations in baseflow, taken to be a reflection of groundwater, vary with discharge, an observation in conflict with the typical assumption of constant concentration used in end-member mixing analyses. This observed flow dependence was modeled by considering the concentration in groundwater to be related to the saturation deficit in this zone. A positive correlation between the average groundwater saturation deficit and baseflow dissolved silica concentrations is consistent with batch experiments and petrographic analysis of regolith core samples, which both indicate an increase in silica available for dissolution with depth in the groundwater zone. In the absence of subsurface stormflow zone sampling during rainfall events, a constant concentration was assumed for this zone. Concentration-discharge (C-Q)

paths in the stream were used to evaluate the modeled stream silica concentrations. An inconsistency in the direction of the modeled C-Q rotations suggests that the stormflow zone dissolved silica concentration may also vary with time, due to the "flushing" of high concentration, pre-event soil water on the rising limb of the storm hydrograph. For this catchment in Virginia, the assumption of a constant concentration for stormflow, as well as for baseflow, appears to be invalid.

The Herring Run Watershed Association 2000-2001 Water Quality Program.

<u>Dan Dillon</u>, Herring Run Watershed Association. Concurrent Session D, 3:00 - 4:30 p.m.

<u>ABSTRACT</u>: In 2000 and 2001 over two hundred volunteers clocked five thousand hours as part of the Herring Run Watershed Association's Water Quality Program funded by the National Fish and Wildlife Foundation. Twenty-six sites in the watershed were regularly sampled for eight parameters of stream health. Five other sites were sampled for macroinvertebrate presence; a partnership with Maryland Save Our Streams Project Heartbeat. Habitat assessments based on Maryland Department of Natural Resources formats were made in several catchment areas of the watershed. Partnerships were made with city, county, state, and federal officials in areas of public works, health, environment, and forestry. Large amounts of data were collected by HRWA. Herring Run Watershed Association's 2000-2001 Water Quality Program was a huge success in terms of volunteer action, data collection, and cooperation across boundaries. This session will address the core-role watershed organizations can play as information resources for the entire environmental community, and the use of GIS and photodocumentation to educate communities about the watershed, and natural environmental issues.

Using Online GIS as a Water Quality Monitoring Tool.

<u>Kenneth Miller</u>, Maryland Department of Natural Resources.

Concurrent Session D, 3:00 - 4:30 p.m.

<u>ABSTRACT:</u> Using internet-based GIS tools can provide a number of different benefits for measuring and tracking water quality monitoring activities. MERLIN Online (www.mdmerlin.net) is meeting several different needs for the Maryland Department of Natural Resources, such as accurately determining station locations and coordinating the efforts of a variety of different monitoring programs. This session will explore how a system like MERLIN Online is being used and how it might be used in the future.

Impervious Surface Mapping of the Chesapeake Bay Watershed.

<u>John Morgan III</u>, Towson University

Concurrent Session D, 3:00 - 4:30 p.m.

<u>ABSTRACT:</u> The Towson University Center for Geographic Information Sciences (CGIS) used remote sensing and Geographic Information System (GIS) technologies to map impervious surfaces in the entire Chesapeake Bay Watershed Area (CBWA) and Maryland's Coastal Bay Watersheds (MCBW). CGIS researchers used an algorithm to classify late winter/early spring 2000 (leaf off) corrected Landsat-7 images. Then digital image processing was performed on a county-by-county basis to map impervious surfaces. An accuracy assessment of the

impervious surface maps is currently underway. To map small watersheds accurately, GIS was used to measure the amount of impervious surface. Empirically-derived impervious surface coefficients were developed for various land uses to improve estimates of impervious surfaces derived from satellite imagery. The resultant impervious surfaces map was “clipped” by watershed and county boundaries that were derived from Federal Geographic Data Committee (FGDC) sources. Finally, GIS was used to prepare a map that identified slightly, moderately, or severely-impacted watersheds based on percentages of impervious surfaces.

A Chesapeake Bay from Space web site has been developed for accessing processed satellite imagery, derived impervious surface maps, impacted watershed maps, and other GIS data. CGIS plans to develop an Internet-based mapping application in the near future. For Towson University’s Center for Geographic Information Sciences (CGIS), the tangible results of the impervious surface mapping project include: 1) development of impervious surface maps using Landsat 7 imagery and related data; 2) provision of “local” data on imperviousness to support water quality planning efforts; 3) development of an effort to encourage use of imperviousness as a measurable environmental indicator by state and local government agencies; 4) documentation of the impact of imperviousness at the small watershed level for water quality modeling efforts by regional and state agencies; and 5) increased availability of LandSat 7 data; impervious surface maps, and related data.